

**WIRELESS LAN SYSTEM AND METHOD FOR THE SAME****BACKGROUND OF THE INVENTION**

The present invention relates to a wireless LAN system  
5 and a method for the same, wherein a mobile terminal  
connects is wirelessly connected to a network so that  
communications are conducted. Particularly, the present  
invention relates to a wireless LAN system and a method  
for the same, wherein communications can be seamlessly  
10 maintained while a mobile terminal is moving between the  
wireless cells of respective base stations connected to a  
network.

In the wireless LAN system that allows a mobile  
terminal to be connected wirelessly to a communication  
15 network while the mobile terminal is freely moving, an  
agent on the communications network manages the location  
of a mobile terminal. To manage the location of a mobile  
terminal, an agent has to register the location of the  
mobile terminal.

20 There are two methods to catalog locations on an agent.  
That is, one is the method in which a mobile terminal  
receives the frame of an agent advertisement periodically  
sent from an agent to catalog the location thereof. The  
other is the method in which a mobile terminal itself  
25 detects an agent to catalog the location thereof.

Generally, in comparison with the latter, the former can more shorten the time period until a mobile terminal establishes communications with the network.

Fig. 4 is a block diagram illustrating the

configuration of a wireless LAN system applied when an agent periodically sends an agent advertisement.

Referring to Fig. 4, the wireless LAN system includes a router  $R_1$ , networks  $NW_1$  and  $NW_2$ , base stations  $BS_1$  to  $BS_4$ , agents  $AD_1$  and  $AG_2$ , and mobile terminals  $MT_1$  to  $MT_4$ . Each of the networks  $NW_1$  and  $NW_2$  is, for example, Ethernet. The router  $R_1$  connects the network  $NW_1$  and the network  $NW_2$ .

The networks  $BS_1$  and  $BS_2$  are in the network  $NW_1$ . The networks  $BS_3$  and  $BS_4$  are in the network  $NW_2$ . The radio cells  $C_1$  to  $C_4$  belong to the base terminals  $BS_1$  to  $BS_4$ , respectively. When the mobile terminal  $MT_1$ ,  $MT_2$ ,  $MT_3$ , or  $MT_4$  is within any one of the radio cells  $C_1$  to  $C_4$ , respectively belonging to the base stations  $BS_1$  to  $BS_4$ , it is connected to the base station in the corresponding radio cell. Thus the corresponding mobile terminal conducts IP (Internet Protocol) communications via the corresponding base station. As shown in Fig. 4, when being within the radio area  $C_1$  of the base station  $BS_1$ , the mobile terminal  $MT_1$  is linked to the base station  $BS_1$ , thus conducting communications via the base station  $BS_1$ .

The agent  $AG_1$  belongs to the network  $NW_1$  while the agent

AG<sub>2</sub> belongs to the network NW<sub>2</sub>. In order to perform the IP mobility support or location management of a mobile terminal connected to the base station BS<sub>1</sub>, BS<sub>2</sub> in the corresponding network, the agent AG<sub>1</sub> periodically sends an agent advertisement frame to all the base stations BS<sub>1</sub> and BS<sub>2</sub> connected to the network NW<sub>1</sub>. In order to perform the IP mobility support or location management of a mobile terminal connected to the base station BS<sub>3</sub>, BS<sub>4</sub> in the corresponding network, the agent AG<sub>2</sub> periodically sends an agent advertisement frame to all the base stations BS<sub>3</sub> and BS<sub>4</sub> connected to the network NW<sub>2</sub>. Each of the base stations BS<sub>1</sub>, BS<sub>2</sub>, BS<sub>3</sub>, and BS<sub>4</sub> sends an agent advertisement frame within its radio area.

When moving from the radio area C<sub>1</sub> of the base station BS<sub>1</sub> to the radio area C<sub>2</sub> of the base station BS<sub>3</sub>, the mobile terminal MT<sub>1</sub> detects its movement because communications to the base station BS<sub>1</sub> are interrupted. Subsequently, the mobile terminal MT<sub>1</sub> newly performs a belonging sequence process to the base station BS<sub>3</sub> and then waits for an agent advertisement issued from the base station BS<sub>3</sub>. When receiving the agent advertisement, the mobile terminal MT<sub>1</sub> changes the setting of the internal network and notifies the agent AG<sub>1</sub> of the movement. When receiving the notice of the movement, the agent AG<sub>1</sub> registers the mobile terminal MT<sub>1</sub> to manage the

location of the mobile terminal MT<sub>i</sub>.

Recently, it has been required that the wireless LAN system quickly can switch from a base station to another base station in accordance with movement of a mobile terminal to more shorten the instantaneous disconnection of communications. The various technologies to solve the above-mentioned demand are disclosed in JP-A No.

56473/1998, JP-A No. 56475/1998, JP-A No. 92562/2000, and Japanese Patent No. 3001490. In order to switch over from a base station to another base station in accordance with movement of a mobile terminal, the mobile terminal first receives an agent advertisement periodically transmitted from an agent. Next, after the mobile terminal transmits a movement notice to the agent, the agent registers the mobile terminal based on the movement notice. To shorten the base station switching time, the time period required for the above-mentioned process has to be reduced.

However, the problem is that even if the above-mentioned technologies are combined together, the processing time cannot be shortened.

As described above, to shorten disconnection of communications more quickly, it is required that the conventional wireless LAN system quickly changes a base station to another base station in accordance with movement of a mobile station. However, because the method

has not been proposed of shortening the time required to enter a mobile terminal in an agent, the problem is that the base station switching time cannot be shortened.

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#### SUMMARY OF THE INVENTION

An object of the present invention is to provide a wireless LAN system and a wireless LAN system control method, that can shorten the time period during which a base station is switched to another base station.

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In order to solve the above-mentioned problem, a wireless LAN system of the invention comprises a plurality of communications networks connected to each other; wireless base stations for periodically transmitting a signal within a wireless cell, at least one of the wireless base stations being disposed in each of the networks; a mobile terminal for transmitting, when newly receiving the signal, a belonging request to a wireless base station which has transmitted the signal and connecting, when receiving permission for belonging from the wireless base station, the mobile terminal to the wireless base station, thus conducting communications; and agents each for distributing an agent advertisement onto the communications networks and managing, after the mobile terminal receives the agent information, the location of the mobile terminal based on movement

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information transmitted from the mobile terminal, each of agents being disposed in each of the communications networks. Each of the base stations stores the agent information based on the agent advertisement distributed  
5 onto the communications network, receives a belonging request from the mobile terminal, and transmits, when belonging of the mobile terminal is permitted, the agent information to the mobile terminal to be stored, together with the permission for belonging.

10 In the wireless LAN system according to the present invention, a wireless base station stores an agent advertisement transmitted from an agent. Thus, when a mobile terminal tries to establish connection, the wireless base station can immediately transmit the agent  
15 advertisement. For that reason, the wireless LAN system does not require that a mobile terminal stands by until an agent transmits an agent advertisement. Therefore, according to the present invention, the wireless LAN system can shorten the time period required to enter the  
20 location of a mobile terminal in an agent, that is, the wireless-base-station changeover time.

#### BRIEF DESCRIPTION OF THE DRAWINGS

This and other objects, features and advantages of  
25 the present invention will become more apparent upon a

reading of the following detailed description and drawings, in which:

Fig. 1 is a block diagram illustrating the configuration of a wireless LAN system according to an embodiment of the present invention;

Fig. 2 is a block diagram illustrating the configuration of a base station in a wireless LAN system according to an embodiment of the present invention;

Fig. 3 is a block diagram illustrating the configuration of a wireless terminal in a wireless LAN system according to an embodiment of the present invention and

Fig. 4 is a block diagram illustrating the configuration of a conventional wireless LAN system.

#### DESCRIPTION OF THE EMBODIMENTS

A wireless LAN system and the control method thereof, according to the present invention, will be described below in detail by referring to the attached drawings.

Fig. 1 is a block diagram illustrating the configuration of a wireless LAN system according to an embodiment. Referring to Fig. 1, the wireless LAN system differs from the conventional wireless LAN system shown in Fig. 4 in that base stations BS<sub>1</sub>' to BS<sub>4</sub>' are included in place of the base stations BS<sub>1</sub> to BS<sub>4</sub>.

Each of the base stations  $BS_1'$  and  $BS_2'$  always monitors an agent advertisement frame periodically sent onto the network  $NW_1$  from agent  $AG_1$ . Each of the base stations  $BS_3'$  and  $BS_4'$  always monitors an agent advertisement frame periodically sent onto the network  $NW_2$  from agent  $AG_2$ . Each of the base stations  $BS_1'$  to  $BS_4'$  receives and stores the frame.

Each of the base stations  $BS_1'$  to  $BS_4'$  receives a belonging request from a mobile terminal newly entered into the radio cell thereof. When belonging is allowable, the base station notifies the mobile terminal of permission for belonging while it transmits a stored agent advertisement frame to the mobile terminal.

As shown in Fig. 1, when the mobile terminal  $MT_1$  moves from the radio area  $C_1'$  of the base station  $BS_1'$  to the radio area  $C_3'$  of the base station  $BS_3'$ , the mobile terminal  $MT_1'$  newly transmits a belonging request to the base station  $BS_3'$ . Meanwhile, the mobile terminal  $MT_1'$  waits for reception of an agent advertisement frame. Because an agent advertisement transmitted from the agent has been already stored, the base station  $BS_3'$  transmits the agent advertisement to the mobile terminal  $MT_1$ .

In a manner similar to that in the prior art, the mobile terminal  $MT_1$  changes the network setting of the agent  $AG_2$  based on the agent advertisement transmitted



from the base station BS<sub>3</sub>' and transmits a movement notice for the agent AG<sub>2</sub> to the base station BS<sub>1</sub>'.

As described above, in the wireless LAN system of the present embodiment, each of the base stations BS<sub>1</sub>' to BS<sub>4</sub>' stores agent advertisements transmitted from the agents AG<sub>1</sub> and AG<sub>2</sub>. Thus, when the mobile terminal MT<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, MT<sub>4</sub> tries to establish connection, the base station can immediately transmit the agent advertisement. For that reason, in the wireless LAN system, it is not required that the mobile terminal MT<sub>1</sub>, MT<sub>2</sub>, MT<sub>3</sub>, MT<sub>4</sub> waits until the agent AG<sub>1</sub>, AG<sub>2</sub> transmits an agent advertisement. As a result, the time period required to catalog the mobile terminal MT<sub>1</sub>, MT<sub>2</sub>, MT<sub>3</sub>, MT<sub>4</sub> in the agent AG<sub>1</sub>, AG<sub>2</sub> can be shortened. The wireless LAN system can shorten the time period during which base stations BS<sub>1</sub>' to BS<sub>4</sub>' are switched over, thus shortening instantaneous disconnection of communications.

Fig. 2 is a block diagram illustrating the configuration of a base station BS<sub>1</sub>', BS<sub>2</sub>', BS<sub>3</sub>', BS<sub>4</sub>' in a wireless LAN system of the present embodiment. Referring to Fig. 2, each of the base stations BS<sub>1</sub>' to BS<sub>4</sub>' includes a wireless transmission/reception circuit 1, a transmission/reception switching circuit 2, an agent advertisement filtering circuit 3, an agent advertisement memory 4, a cable network interface circuit 5, a terminal

belonging management circuit 6, and an agent advertisement transmission circuit 7. A bi-directional transmission/reception line, which is used in communications between a mobile terminal and a communication destination, is inserted between the transmission switching circuit 2 and the cable network interface circuit 5.

The base station  $BS_1'$ ,  $BS_2'$ ,  $BS_3'$ ,  $BS_4'$  is linked to a network via the cable network interface circuit 5. The cable network interface circuit 5 monitors an agent advertisement frame periodically sent from an agent and then outputs a received agent advertisement to the agent advertisement memory 4 via the agent advertisement filtering circuit 3. The agent advertisement filtering circuit 3 filters signals on the network and extracts an agent advertisement frame. The agent advertisement memory 4 stores the agent advertisement extracted by the agent filtering circuit 3.

The wireless transmission/reception circuit 1 is an interface circuit that connects a mobile terminal to a base station by wireless. The transmission/reception switching circuit 2 switches over between wireless transmission and wireless reception. A base station implements wireless transmission/reception to a mobile terminal, using the wireless transmission/reception

circuit 1 and the transmission/reception switching circuit 2. For example, the CSMA/CA scheme is used as the wireless communications scheme of the wireless station.

The terminal belonging management circuit 6 detects  
 5 that a belonging request is transmitted from a mobile terminal. When detecting that a belonging process is performed to a mobile terminal, the terminal belonging management circuit 6 notifies the agent advertisement transmission circuit 7 of the detection. In response to  
 10 the notice, the agent advertisement transmission circuit 7 reads out an agent advertisement from the agent advertisement memory 4 and transmits the agent advertisement to the mobile terminal via the wireless transmission/reception circuit 1 and via the  
 15 transmission/reception switching circuit 2.

Fig. 3 is a block diagram illustrating the configuration of a mobile terminal in a wireless LAN system according to an embodiment. Referring to Fig. 3, a mobile terminal includes a wireless  
 20 transmission/reception circuit 8, a transmission/reception switching circuit 9, an agent advertisement reception circuit 10, an agent connection processing circuit 12, a base station decision circuit 13, and a belonging processing circuit 14. The terminal 11,  
 25 which is, for example, a notebook-size personal computer

to be connected to a mobile terminal, has a network setting changing circuit 15. A bi-directional transmission/reception circuit used when the terminal 11 communicates with a communication destination on a network is inserted between the transmission/reception switching circuit 9 and the terminal 11.

The wireless transmission/reception circuit 8 is an interface circuit that connects a mobile terminal to a base station by wireless. The transmission/reception switching circuit 9 switches over between wireless transmission and wireless reception by wireless transmission/reception circuit 8. A mobile terminal conducts wireless transmission/reception between the mobile terminal and a base station, using the wireless transmission/reception circuit 8 and the transmission/reception switching circuit 9. As the wireless LAN communications scheme of the base station, there is, for example, the CSMA/CA scheme.

The base station decision circuit 13 detects signals (e.g. beacon) periodically transmitted from a base station. If signals are not detected, the base station decision circuit 13 judges that the self station has moved out from the radio cell of the base station. Moreover, when detecting signals periodically transmitted from other base station, the base station decision circuit 13

notifies the belonging processing circuit 14 of the detection. When receiving the notice, the belonging processing circuit 14 transmits a belonging request signal to the base station via the wireless transmission/reception circuit 8 and via the transmission/reception switching circuit 9.

The agent advertisement reception circuit 10 detects reception of an agent advertisement. When detecting reception of an agent advertisement, the agent advertisement reception circuit 10 notifies the agent connection processing circuit 12 of the detection. Meanwhile, the agent advertisement reception circuit 10 outputs a request to the network setting changing circuit 15 to change the network setting of the terminal 11 based on the agent advertisement information. When receiving the notice saying that reception of an agent advertisement has been detected, the agent connection processing circuit 12 transmits a movement notice for an agent to the base station via the wireless transmission/reception circuit 8 and via the transmission/reception switching circuit 9.

When receiving a request for changing the network setting, the network setting changing circuit 15 in the terminal 11 changes the network setting of the terminal 11 in accordance with the request. For example, in the

mobile terminal, when each of the networks  $NW_1$  and  $NW_2$  shown in Fig. 1 is a communications network conducting communications with the TCP/IP, an agent advertisement transmitted by each agent stores the IP address of an agent. As shown in Fig. 1, when a mobile terminal is handed over from the base station  $BS_1$  to the base station  $BS_2$  or is connected to a base station in a different network, the agent advertisement reception circuit 10 notifies the network setting changing circuit 15 of the IP address of an agent contained in the agent advertisement, together with a network setting changing request. The network setting changing circuit 15 changes the IP address notified of the setting of the IP address of an agent.

In the mobile terminal in the wireless LAN system of the present embodiment, when a standard mobile IP is supported in the TCP/IP module of the terminal 11, the agent advertisement reception circuit 10 and the agent connection processing circuit 12 are disposed as described above. In such a configuration, the current agent can be quickly grasped without changing the mobile IP process. When the terminal 11 has the function of the agent advertisement reception circuit 10 and the function of the agent connection processing circuit 12, it is not required to prepare the agent advertisement reception

circuit 10 and the agent connection processing circuit 12 in the mobile terminal.

In the wireless LAN system of the present embodiment, the base station BS<sub>1</sub>' transmits an agent advertisement  
 5 itself to a mobile terminal. However, the present should not be limited only to the wireless LAN system of the embodiment. The base station may transmit to a mobile terminal only valuable information such as the IP address of an agent of information contained in an agent  
 10 advertisement. In such a case, the traffic volume between the base station and the mobile terminal is more decreased so that the radio band can be utilized effectively.

The base stations are completely stationary. When  
 15 grasping the installation place, a network administrator may set the IP address of an agent in the network to the base station, using SNMP (Simple Network Management Protocol). SNMP means a network management protocol in the TCP/IP. In such a configuration, the radio band  
 20 between a base station and a wireless station can be effectively utilized. Because the agent advertisement filtering circuit 3 is reduced in the configuration of the base station in Fig. 2, the configuration of the base station can be more simplified.

25 As described above, the wireless LAN system and the

method thereof according to the present invention have the following advantages.

1. A wireless base station stores an agent advertisement transmitted from an agent. Thus, when a  
5 mobile terminal tries to establish connection, the wireless base station can immediately transmit the agent advertisement. This does not require that the mobile station waits for the agent advertisement transmitted from the agent for a long time. Therefore, the wireless  
10 LAN system can shorten the time required to catalog an agent advertisement in the agent, that is, the wireless station changeover time, thus decreasing the communication disconnection time.

2. A base station is not required to  
15 periodically originate an agent advertisement to radio cells. This enables to lessen the traffic volume between a base station and a wireless station. Thus, the wireless band can be effectively utilized.

3. When a standard mobile IP is supported in the  
20 TCP/IP module, a mobile terminal includes, for example, an agent advertisement reception circuit and an agent connection processing circuit. Thus, the current agent can be quickly grasped without changing the mobile IP process.